Journal of Surgical Oncology 63:65–70 (1996)

REVIEW

Malignant Tracheo-Esophageal Fistula: Use of Esophageal Endoprosthesis

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Malignant tracheo-esophageal fistula (TEF) is a serious complication of cancer arising usually in the esophagus, lung, or tracheobronchial tree. Repeated aspiration and pneumonia lead to rapid deterioration and death. The prognosis is dismal and curative resections are curiosities. Surgical bypass of the lesion has been performed but is associated with 25–61% mortality. Other treatments have been employed, such as enterostomies, esophageal endoprostheses, and supportive care. The reported mortality of palliative procedures using endoprostheses, surgical bypass, or exclusion is almost identical. A retrospective review of the data over the past decade revealed a trend toward insertion of endoprostheses. Insertion of endoprostheses can be performed in an endoscopy suite, under sedation, and has fewer major complications than occur with a surgical approach. The periprocedure mortality rate for these patients is 15%, compared to a 29–47% perioperative mortality for patients undergoing surgery. Even so, patients after surgical procedures could survive for 8 months or more, which is better than survival after endoprosthesis intubation. We conclude that insertion of an esophageal endoprosthesis should be the usual preferred option for palliative treatment of malignant TEF. However, for special candidates a surgical procedure is a valid option.

KEY WORDS: **palliative treatment, endoprosthesis, enteric interposition, bypass**

INTRODUCTION

The development of a malignant tracheo-esophageal fistula (TEF) is a serious complication of a cancer originating in the esophagus, lung, or the tracheobronchial tree. The extent of the disease almost always precludes curative attempts so palliative measures are the usual goal of therapy. The presence of a fistula between the respiratory passages and the esophagus leads to repeated aspiration of saliva and enteric contents. In addition, it prevents oral intake, contributing to the development of severe malnutrition. Bronchopneumonia and sepsis are the terminal events, and rapid deterioration occurs if the condition is not treated. The incidence of malignant (TEF) complicating esophageal and bronchopulmonary malignancies is within the range of 4.3–8.1% for esophageal and 0.16–0.3% for bronchopulmonary cancer [1–4]. Most TEFs develop as a result of esophageal or pulmonary malignancies, but there have been incidents of fistulas following thyroid cancer, lymphoma, and leiomyosarcoma of the esophagus [2,5]. The fistula usually extends between the esophagus and the trachea or proximal tracheobronchial tree but may penetrate distally to the bronchial tree or even the pulmonary parenchyma [1,6]. With-

Accepted for publication December 15, 1995.
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out treatment, the mean life expectancy of these patients is only a few weeks [2]. A variety of palliative methods have been used over the years for the management of this condition. These include the use of esophageal endoprostheses, enteric interposition, bipolar fistula exclusion surgery and supportive therapy with or without an enterostomy [1,2].

MATERIALS AND METHODS

A review of the English literature was performed using Medline, and the data are gathered from the past 12 years for comparison of the various modes of therapy. Twenty-one of the largest publications describing treatment of 565 patients were reviewed and compared for the different palliative treatments, the morbidity and mortality of the procedures, and the mean survival. The criteria for entering the review were based on the number of cases or procedures performed. Case reports were not included. Only those series with 8 or more intubations were included for the review of esophageal endoprosthesis insertion. Some of the morbidity data (in percentage) in this review were taken from reports of treatments of malignant esophageal obstruction, of which TEF comprise only a part. This information thus relates to the whole group of malignant esophageal obstruction and is not specific to TEF. Furthermore, the procedure-related mortality was not always available specifically for the TEF group, and it was calculated by its relative percentage. Data that refer to, or are calculated from, the whole series of malignant esophageal obstruction are marked by an asterisk (*) in the tables. Although these are only estimates of the actual morbidity and mortality, we believe they are fairly close to the real values.

Esophageal endoprostheses were used in 249 patients. Enteric interposition procedures employing the stomach or colon were done in 101 patients. Esophageal exclusion was performed in 45 patients. Supportive measures including enterostomy creation were used in 170 patients. Post-procedure mortality was defined as death within 30 days of surgery or procedure. "In-hospital" mortality data were available for 10 publications and could not be retrieved for 11 publications [1,6–15].

RESULTS

Table I [1,7–12,16–23] describes data collected for 249 patients who underwent placement of an esophageal endoprosthesis. Unsuccessful intubations occurred in 27 patients (11%). Nine different types of endoprosthetic tubes were used by the various investigators. There were no differences in the morbidity and mortality rates of the patients treated with the various types of tubes. This involved mainly 2–14% perforations and 13–24% tube migrations or dislodgments. The total number of periprocedural deaths was 37, representing 15% mortality. Table II [1,6,13–15,17,24,25] summarizes the data for 101 patients who underwent the enteric interposition procedure. The stomach or the colon were the usual organs used for bypassing the TEF. The morbidity was remarkable for anastomotic leaks and disruptions (up to 30%) and combined perioperative mortality was 29% (29 patients). Results for the bipolar esophageal exclusion procedure are shown in Table III [1,6,13,14]. A total of 45 patients underwent this procedure, of which there were 21 deaths for a mortality of 47%. The results of supportive care with or without an enterostomy are shown in Table IV [1,6,16,17,25]. A total of 170 patients received these modes of therapy. The 30-day mortality for patients in this group was 41% (69 deaths).

DISCUSSION

A TEF can develop in 4.3–8.1% of all patients with esophageal cancer and in 0.16–0.3% of patients with pulmonary carcinoma [1–4]. Its formation may sometimes be accelerated by the administration of radiation therapy and/or chemotherapy [1,26]. The resulting communication between the gastrointestinal and respiratory tracts allows saliva and ingested food to enter the bronchopulmonary tree. In addition, the growing tumor may obstruct the esophagus and prevent effective intake of food contributing to the malnutrition state. At this stage the life expectancy of the patient is limited to a few weeks [2], and the condition is usually incurable [1–4]. Therapy should be directed toward palliation so that the patient can be comfortable for his remaining life span. The two goals that must be accomplished are relief of dysphagia and protection of the respiratory tract from continued contamination with saliva, food, or refluxed gastric material. If both goals are achieved, there is hope that the patient can be discharged from the hospital. Unfortunately, many reported successful procedures failed to improve the patients' condition to the point that they were able to be released from the hospital and the "in-hospital" mortality (when the data is given) is often higher than the 30-day mortality [16,21,23]. There are two basic types of treatments that can achieve the goals of palliation: the placement of an esophageal endoprosthesis and bypass of the TEF with enteric interposition. Other modes of palliative therapy may be employed but do not achieve those specific goals. These include bipolar esophageal exclusion, enterostomy creation, supportive therapy without intervention, or any combination of these [1–4].

Esophageal Endoprosthesis

Symonds [27] was among the first to use an indwelling tube for palliative treatment of esophageal cancer. Fixation of the early tubes was a major difficulty. In the intervening years varieties of endoprostheses were developed. The Souttar [28] prosthesis was the mainstay for more then 30 years. During the late 1950s, pull-through tubes were devised by Mousseau-Barbin [29] and Celestin

TABLE I. Esophageal Endoprosthesis for Malignant Tracheo-Esophageal Fistula

Investigators	Year	No. of pts.	Type of tube	Morbidity	Mortality	Mean survival (mo)	Comments
Boyce [16]	1982	19	Polyvinyl	2 intubation failures	3[a]	3	6 deaths in hospital mean 4.8 wk
Symbas et al. [17]	1983	9 1	Mousseau-Barbin Celestin	N/A	2	1.8	—
Lux et al. [10]	1983	15	N/A	12% intubation failures[a] 24% dislodgment[a] 10% perforations[a]	4[a]	2	—
Robertson and Atkinson [18]	1986	11	Atkinson	1 food stagnation 3 contrast radiologic fistulas	1	2 (median)	10 discharges home
Gasparri et al. [8]	1986	20	Medoc Atkinson Celestin	2% perforations[a]	4	Most pts 3–6	—
Chavy et al. [11]	1986	12	Celestin Atkinson	15% intubation failures[a] 14% perforations[a]	N/A	3.2 (median)[a]	4% death for the entire series
Van den Brandt-Grädel et al. [9]	1987	38	Tygon	7 intubation failures 40% complications[a]	2[a]	3.7[a]	7/26 failures of the lung cancers
Buess et al. [19]	1988	21	Eska Buess	None	2	3.5	6 pts former failure of other tubes; 19 pts d/c home
Hordijik et al. [20]	1990	10	Wilson-Cook	1 intubation failure	1	N/A	9 patients had average 37.2 symptom-free days
Buset et al. [21]	1990	10	Tygon	3 intubation failures 1 respiratory arrest 2 erosions to main vessel	7	5	All are hospital deaths
Spinelli et al. [12]	1991	7 7 5	Celestin Atkinson Wilson-Cook	2 dislodgments	1 1	4.6 4.9 4.5	2 uncomplicated tubes dislodgments
Burt et al. [1]	1991	14	N/A	N/A	6	1.2 (median)	—
Cusumano et al. [22]	1992	34	Celestin	9 intubation failures 24% complications[a] 13% dislodgments[a] 6% perforations[a]	1[a]	3.9 (median)[a]	Hospital death
Do et al. [23]	1993	8	Gianturco	None	1	2.2	3 pts. alive at mean 3 mo 4 pts d/c from hospital
Wu et al. [7]	1994	8	Gianturco	2 partial seals 31% complications[a] 13% stent migrations[a]	1	3.4	2 pts. alive at mean 4.5 mo

[a]The number is calculated, and the percentage refers to the entire esophageal cancer series, including patients without tracheo-esophageal fistula.
N/A, not available (data not available in the publication); d/c, discharged; pts, patients.

TABLE II. Enteric Interposition for Malignant Tracheo-Esophageal Fistula

Investigators	Year	No. of pts	Morbidity	Mortality	Mean survival (mo)	Comments
Campion et al. [13]	1983	11	N/A	3	8	3 survived >1 yr
Steiger et al. [14]	1983	17	3 anastomotic leaks	5	7	Gastric bypass
Orringer [24]	1984	13	19% anastomotic leaks[a] 17% anstomotic disruptions[a]	3	6.6	Gastric bypass Hospital deaths
Conlan et al. [15]	1984	18	5 anastomotic leaks Bronchopneumonia	9	3.5	Gastric bypass Hospital deaths
Symbas et al. [17]	1984	4	1 pulmonary emboli	None	1–26	3 gastric, 1 colon bypass
Little et al. [6]	1984	7	2 anastomotic leaks Abscess, anastomotic disruption	None	6.2 median	Longer survival with colonic bypass
Burt et al. [1]	1991	28	N/A	7	2.5 (median)	Longer survival for gastric bypass
Hause et al. [25]	1992	3	N/A	2	1 pt at 8.7	Gastric bypass

[a]The % number refers to the entire esophageal cancer series, including patients without tracheo-esophageal fistula.
N/A, not available (data not available in the publication); pts, patients.

TABLE III. Bipolar Esophageal Exclusion for Malignant Tracheo-Esophageal Fistula

Investigators	Year	No. of pts	Morbidity	Mortality	Mean survival (mo)	Comments
Steiger et al. [14]	1983	4	N/A	4	None	Immediate postoperative deaths
Campion et al. [13]	1983	5	N/A	1	5.5	—
Little et al. [6]	1984	7	N/A	N/A	3.5 (median)	Red rubber catheter for esophageal drainage
Burt et al. [1]	1991	29	N/A	16	1 (median)	80% died of pulmonary sepsis

N/A, not available (data not available in the publication); pts, patients.

TABLE IV. Supportive or Enterostomy Without Exclusion for Malignant Tracheo-Esophageal Fistula

Investigators	Year	No. of pts	Mortality	Mean survival	Comments
Boyce [16]	1982	7	N/A	1 mo	Supportive
Symbas et al. [17]	1984	3	3	—	Supportive
		7	3	1.2 mo	Gastrostomy
Little et al. [6]	1984	10	—	1.2 mo (median)	Supportive
Burt et al. [1]	1991	104	58	22 days (median)	Supportive and/or enterostomy
		20	4	2 mo median	Radiation
Hause et al. [25]	1992	2	1	6.7 mo	Gastrostomy
		17	—	21 days (median)	Supportive

N/A, not available (data not available in the publication); pts, patients.

[30]. However, the procedure required the use of laparotomy with gastrotomy under general anesthesia. With the development of fiberoptic endoscopy, Atkinson and Ferguson [31] in 1977 reported the use of a Nottingham introducer to place the prosthesis orally. In most instances this required esophageal dilatation. In the following years, mortality associated with the endoscopic insertion of these endoprostheses was reported to be 2–12.5% [32,33]. During the early 1980s, two techniques of endoprosthesis insertion were reviewed by Duranceau and Jamieson [2]: push-through (or pulsion) intubation and pull-through (or traction) intubation. There appeared to be a higher mortality rate with the traction technique and its use has declined in recent years in favor of the peroral pulsion technique carried out in the endoscopy suite [7–9,18,19,22,32–34]. Duranceau and Jamieson [2] cited a 25–35% mortality rate for the endoprosthesis insertion. In our review of the more recent publications, we found a 30-day mortality of 15%. Most tubes used today are modifications of the early ones reviewed by Duranceau. The Atkinson tube is

made of silicone, has an internal diameter of 11 mm, and has a firm noncircumferential flange at the distal end. The Celestin tube is made up of latex with a nylon-reinforced spiral and has a circumferential and a less rigid flange that is compressed on insertion and opens out once the tumor is passed. The Cook tube is similar to the Celestin tube but is manufactured from polyethylene and has a version with an expanding balloon in the body of the tube (Fig. 1). The Tytgat tube is a Tygon prosthesis tailor-made to fit an individual patient's tumor [35]. The modified Gianturco tube is a self-expanding metallic tube covered with silicone, and the Eska-Buess tube is a silicone tube with a metal spiral embedded within the wall for stability. With the availability of many such tubes and the growing expertise of the endoscopists, the mortality rates associated with the procedure have fallen. Placement of appropriate esophageal endoprostheses obliterates the TEF, prevents aspiration, permits swallowing of saliva and soft, well-ground food, and restores the enjoyment of eating for the remaining weeks or months that the patient can survive. The endoprosthesis is usually well tolerated, with no sensation of the presence of a foreign body, provided the proximal funnel rim is located at least 2 cm distal to the cricopharyngeus muscle [36]. It can be placed in an endoscopy suite under sedation as a relatively brief procedure [8,9,19,22,35,36]. Radiographic control using intraprocedural fluoroscopy is essential; a post-placement radiograph should also be taken to exclude any perforation and to confirm the position of the tube [7,23,36]. The patient may be allowed a liquid diet on the same day, with gradual progression as tolerated. Early complications associated with the insertion of esophageal endoprostheses include failure of the procedure, perforation, hemorrhage, and infections. Other rare early complications are related to the pharyngeal irritation and transient chest pain. Late complications are due to bolus obstruction of the tube, dislodgment of the tube, obstruction of the tube by the tumor and gastroesophageal reflux [35]. Rarely, the tube can erode into the major blood vessels in the vicinity and lead to lethal bleeding [1,2]. Thus, the procedure achieves both goals of effective palliation; the resumption of swallowing and oral intake and the prevention of repeated attacks of aspiration induced bronchopneumonia. In our institution we have been using the inflatable Wilson–Cook tubes (Fig. 1). The patients undergo the procedure at the endoscopy suit under intravenous sedation. Dilatations are usually performed with gradually tapering Savory bougies over previously placed guidewire. In case of complete obstruction, when a guide wire cannot be inserted and dilation cannot be done safely, we use the Nd:YAG laser in the operating room to establish a lumen prior to the mechanical dilatation [34]. Proper placement of the prostheses are confirmed by fluoroscopy and endoscopy. Later, chest roentgenogram is done to check for possible perforation.

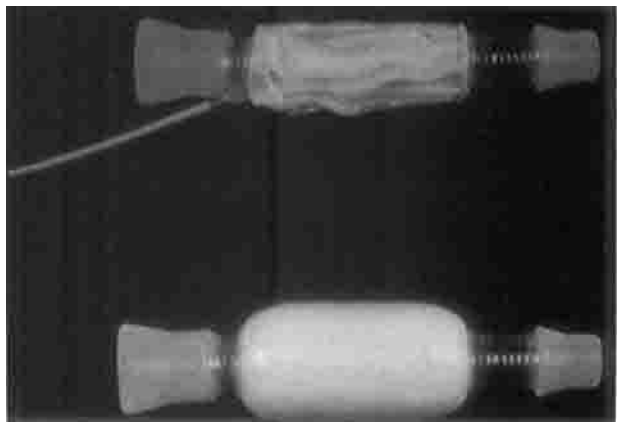

Fig. 1. Cuffed balloon endoprosthesis (Wilson-Cook, Winston-Salem, NC).

Enteric Interposition

The only other palliative treatment that can achieve those goals is enteric interposition bypassing the TEF. This procedure uses the stomach, colon, or jejunum as esophageal substitutes while performing substernal bypass. This entails major surgery in an already debilitated and malnourished patient. The resulting morbidity and mortality in the past was 33–61% [2]. Since the early 1980s, the mortality rates for the insertion of esophageal endoprostheses has fallen, while that for enteric interposition has not improved. In our review of the more recent literature, the mortality rate for 101 patients who underwent enteric interposition bypass was 29%. The extent of the procedure, the need for general anesthesia, and postoperative complications make this procedure a high risk for this group of patients. Nevertheless, the survival time for those who survived the operation was longer than for the endoprosthesis group and this may be an option in special instances or an alternative for intubation failure.

Bipolar Esophageal Exclusion and Supportive Measures

Such measures do not achieve the goals of effective palliation. Neither enables the patient to swallow, and repeated aspiration continues after the supportive therapy. Even so, these approaches are still used and have been reported in the literature. The mortality rates of the bipolar exclusion is high, and it should be reserved for special situations only.

CONCLUSION

TEF is a devastating complication mostly caused by incurable neoplastic disease of the esophagus or the respi-

ratory tract. Effective palliation should enable the patient to resume oral intake and prevent repeated aspiration. Insertion of esophageal endoprosthesis using fiberoptic endoscopy has emerged as the major palliative modality over the last decade, with the lowest morbidity and mortality rates, while other palliative methods carry high mortality rates and may not achieve the goals of palliation. Still one should bear in mind that those patients who do survive the surgical procedures have a somewhat longer survival. We conclude that the insertion of esophageal endoprosthesis is the preferred palliative modality in TEF and recommend that patients suffering from this condition undergo endoprosthesis placement as the first option. However, enteric interposition remains an option for selected patients.

REFERENCES

1. Burt M, Diel W, Martini N, et al.: Malignant esophagorespiratory fistula: Management options and survival. Ann Thorac Surg 52:1222–1229, 1991.
2. Duranceau A, Jamieson GG: Malignant tracheoesophageal fistula. Ann Thorac Surg 37:346–354, 1984.
3. Lolley DM, Ray JF, Ransdell HT, et al.: Management of malignant esophagorespiratory fistula. Ann Thorac Surg 25:516–520, 1978.
4. Martini N, Goodner JT, D'Angio GJ, Beattie EJ: Tracheoesophageal fistula due to cancer. J Thorac Cardiovascular Surg 59:319–324, 1970.
5. Gudovsky LM, Koroleva NS, Biryukov YB, et al.: Tracheoesophageal fistulas. Ann Thorac Surg 55:868–875, 1993.
6. Little AG, Ferguson MK, DeMeester TR, et al.: Esophageal carcinoma with respiratory tract fistula. Cancer 53:1322–1328, 1984.
7. Wu WC, Katon RM, Saxon RR, et al.: Silicon-covered self-expanding metallic stents for the palliation of malignant esophageal obstruction and esophagorespiratory fistulas: Experience in 32 patients and review of the literature. Gastrointest Endosc 40:22–33, 1994.
8. Gasparri G, Casalegno PA, Camandona M, et al.: Endoscopic insertion of 248 prostheses in inoperable carcinoma of the esophagus and cardia: Short-term and long-term results. Gastrointest Endosc 33:354–356, 1987.
9. Van Den Brandt-Grädel V, den Hartog Jager FCS, Tytgat GNJ. Palliative intubation of malignant esophagogastric obstruction. J Clin Gastroenterol 9:290–297, 1987.
10. Lux G, Groiti H, Rienmann JF, Demling L: Tumor stenosis of the upper gastrointestinal tract—Non-surgical therapy by bridging tubes. Endoscopy 15:207–212, 1983.
11. Chavy AL, Rougier M, Pieddeloup SA, et al.: Esophageal prosthesis for neoplastic stenosis. Cancer 57:1426–1431, 1986.
12. Spinelli P, Cerrai FG, Mancini A, et al.: Esophageal intubation for malignant fistulas. Surg Endosc 5:127–129, 1991.
13. Campion JP, Bourdelat D, Launois B: Surgical treatment of malignant esophagotracheal fistulas. Am J Surg. 146:641–646, 1983.
14. Steiger Z, Wilson RF, Leichman L, et al.: Management of malignant bronchoesophageal fistulas. Surg Gynecol Obstet 157:201–204, 1983.
15. Conlan AA, Nicolaou N, Delikaris PG, Pool R: Pessimism concerning palliative bypass procedures for established malignant esophagorespiratory fistulas: A report of 18 patients. Ann Thorac Surg 37:108–110, 1984.
16. Boyce HW: Medical management of esophageal obstruction and esophageal-pulmonary fistula. Cancer 50:2597–2600, 1982.
17. Symbas PN, McKeown PP, Hatcher CR, et al.: Tracheoesophageal fistula from carcinoma of the esophagus. Ann Thorac Surg 38:382–386, 1984.
18. Robertson CS, Atkinson A: A modified prosthetic oesophageal tube to manage malignant oesophago-respiratory fistula. Lancet 25:949–950, 1986.
19. Buess G, Schellong H, Kometz B, et al.: A modified prosthesis for the treatment of malignant esophaotracheal fistula. Cancer 61:1679–1684, 1988.
20. Hordijk ML, Dees J, van Blankenstein M: The management of malignant esophago-respiratory fistulas with a cuffed prosthesis. Endoscopy 22:241–244, 1990.
21. Buset M, Des Marez B, Cremer M: Endoscopic palliative intubation of the esophagus invaded by lung cancer. Gastrintest Endosc 36:357–359, 1990.
22. Cusumano A, Ruol A, Segalin A, et al.: Push-through intubation: Effective paliation in 409 patients with cancer of the esophagus and cardia. Ann Thorac Surg 53:1010–1014, 1992.
23. Do YS, Song HY, Lee BH, et al.: Esophagorespiratory fistula associated with esophageal cancer: Treatment with Gianturco stent tube. Radiology 187:673–677, 1993.
24. Orringer MB: Substernal gastric bypass of the excluded esophagus-Results of an ill-advised operation. Surgery 198:467–470, 1984.
25. Hause DW, Kagan AR, Fleischman E, Harvey JC: Tracheo-esophageal fistula complicating carcinoma of the esophagus. Am Surg 58:441–442, 1992.
26. Fitzgerald RH, Bartles DM, Parker EF: Tracheoesophageal fistula secondary to carcinoma of the esophagus. J Thorac Cardiovasc Surg 82:194–197, 1981.
27. Symonds CJ: A case of malignant stricture of the esophagus illustrating the use of the new form of esophageal catheter. Trans Clin Soc Lond 18:155–158, 1885.
28. Souttar HS: A method of intubating the oesophgus for malignant stricture. BMJ 1:782–783, 1924.
29. Mousseau MM, LeForestier J, Barbin J, Hardy M: Place d'intubation à demerure dans la traitment paliatif de cancer Arch Mal Appl Dig 45:208–214, 1956.
30. Celestin LR: Permanent intubation in inoperable cancer of the oesophagus and cardia. Ann R Coll Surg Engl 25:165–170, 1959.
31. Atkinson M, Ferguson R: Fiberoptic endoscopic palliative intubation of inoperable oesophago-gastric neoplasms. BMJ 1:266–267, 1977.
32. Den Hartog Jager FCA, Bartelsman JFWM, Tytgat GNJ: Palliative treatment of obstructing esophagogastric malignancy by endoscopic positioning of plastic prostheses. Gastroenterology 77: 1008–1019, 1979.
33. Jones DB, Davies PS, Smith PM: Endoscopic insertion of palliative esophageal tubes in esophagogastric neoplasms. Br J Surg 68:197–198, 1981.
34. Ghazi A, Nussbaum M: A new approach to the management of malignant esophageal obstruction and esophagorespiratory fistula. Ann Thorac Surg 41:531–534, 1989.
35. Watson A: Endoscopic stents for the palliation of cancer of the esophagus. In Wastell C, Nyhus LM, Donahue PE (eds): "Surgery of the Esophagus, Stomach, and Small Intestine." 5th Ed. 1995, p311–316.
36. Tytgat GNJ, den Hartog Jager FCA, Bartelsman JFWM: Endoscopic prosthesis for advanced esophageal cancer. Endoscopy 18:32–39, 1986.